REMARKS

The above Amendments and these Remarks are in reply to the Office Action mailed 03 November 2006. No fee is due for the addition of any new claims.

Claims 1-9, 13 and 14 were pending in the Application prior to the outstanding Office Action. In the Office Action, the Examiner objected to claim 5 and rejected claims 1-9, 13 and 14. The present Response cancels claim 14, amends claims 1 and 5, and adds new claim 15, leaving for the Examiner's present consideration claims 1-9, 13 and 15. Reconsideration of the rejections is requested.

I. OBJECTION TO RESPONSE A FOR THE ADDITION OF NEW MATTER

The Examiner objected to the amendment made by applicants to a formula on page 5 of the specification as introducing new matter. The Examiner states that the added material is not supported by the original disclosure, because "the reason for the amendment was not clear, and the change in the formula may significantly impact the design of the stated invention."

Applicant responds that no new matter is added, since a person of ordinary skill would have no problem in recognizing the error in the original equation, and in knowing how to correct it.

The formula on page 5 describes mathematically the width w(t) of the shape of a waveguide taper, and the amendment to the formula corrected a typographical transcription error. The incorrect formula, in the specification as filed, was:

$$w(t) = w_{in} + (w_{out} - w_{in})(1 - \cos(\mathbf{2}\pi t))/2$$

The correct formula, as set forth in Applicant's Response A filed 29 September 2006, is:

$$w(t) = w_{in} + (w_{out} - w_{in})(1 - \cos(\pi t))/2$$

That is, the error was in the argument of the cosine term. As originally filed the argument read "**2**πt", whereas it should have read "πt ", half of what was originally filed.

A correction of an error does not constitute "new matter" "if one skilled in the art would appreciate not only the existence of the error in the specification but what the error is." *Ex parte Brodbeck*, 199 USPQ 230, 231 (Pat. Off. Bd. App. 1977). In the present case a person of ordinary skill would have recognized that the formula as originally filed contradicts the remainder of the specification as originally filed for at least 3 different reasons, all of which lead independently to the same corrected formula. The person therefore would know that the

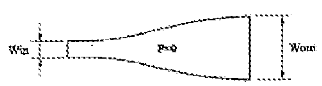
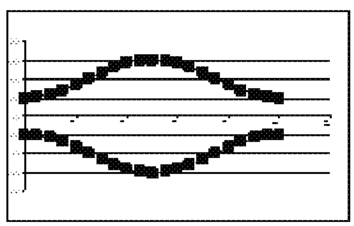
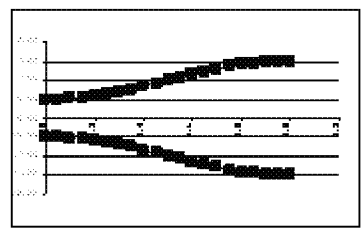
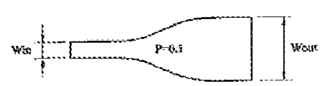
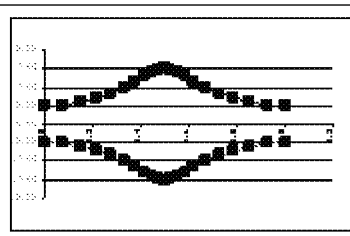
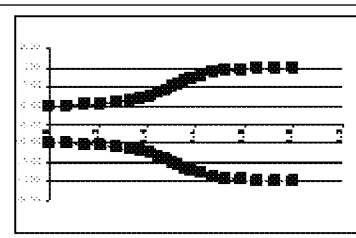
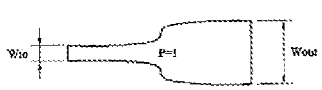
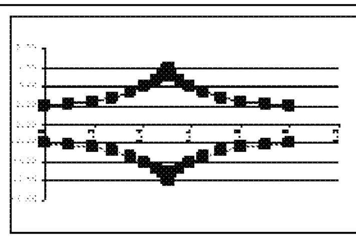
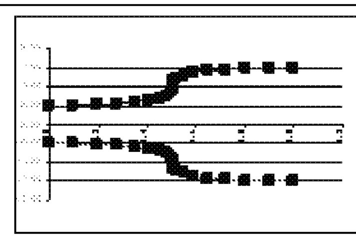
specification as a whole overwhelmingly teaches the corrected version of the formula, and would therefore know how to correct the formula as originally filed.

The error and its correction would be apparent to the person of ordinary skill because:

- The drawings lead the reader to the corrected formula,
- The text leads the reader intuitively to the corrected formula, and
- The text delivers the correct equation purely by mathematical derivation.

A. The Drawings Lead The Reader To The Corrected Formula

The shapes in Figs. 7(a)-7(c) (collectively "Fig. 7") illustrate the waveguide shapes that the correct formula would produce, for three values of the parameter p (p=0, p=0.5 and p=1). Set forth below is a table showing the drawing as filed in column 1, a new plot of the formula as filed in column 2, and a new plot of the formula as corrected in column 3:

Drawings as filed	**Plot per formula as filed** $w(t) = w_{in} + (w_{out} - w_{in})(1 - \cos(2\pi t))/2$	**Plot per formula as corrected** $w(t) = w_{in} + (w_{out} - w_{in})(1 - \cos(\pi t))/2$
 FIG. 7(a) p=0		
 FIG. 7(b) p=0.5		
 FIG. 7(c) p=1		

It is apparent immediately that the formula as filed does not match the drawings as filed, and the formula as corrected does.

Moreover, it would be apparent to a person of ordinary skill from looking at the plots in column 2, exactly what needs to be corrected in the formula as filed in order to produce plots matching those of the drawings as filed. In particular, the person would note from the drawings in column 2 that for all three values of p, the width of the waveguide starts at w_{in} and grows to the output width w_{out} halfway along and then goes back again to the input width w_{in}. Thus, the width variation as defined by the formula as originally filed varies two times as quickly as what is shown in the drawings as filed. Since the parameter responsible for the speed of the width variations (i.e. the longitudinal positions, left-to-right, at which the variations occur) is the argument of the cosine term in the formula for w(t), it would be evident to the person that this argument should be half what is shown in the formula as filed. With this reasoning the person of ordinary skill would come up with the above "formula as corrected", and would plot it and confirm that the resulting plots match the drawings as filed exactly, for all three example values of p.

The Examiner may take the position that reference to the drawings for evidence of the intended shape is not allowed, since 37 CFR 1.84(k) says that indications of scale on drawings are not permitted in patent drawings. But in the above discussion the person of ordinary skill would not be relying on the *scale* of the drawings, only their *shape*. The reason given in the rule for prohibiting indications of scale in the drawings is that scales "lose their meaning with reproduction in a different format." 37 CFR 1.84(k). Whereas that may be true for the *size* of elements in the drawing, it is not a problem for the *shape* of elements in the drawing. There is no reason under 37 CFR 1.84(k) for prohibiting reliance by the person of ordinary skill on the *shape* of the waveguides as shown in the Fig. 7 drawings as originally filed.

Accordingly, it is submitted that not only would a person of ordinary skill know from the originally filed drawings that the formula as filed is incorrect, but also would know exactly what needs to be corrected in the formula as filed in order to produce matching plots. And the person would come up with the "formula as corrected" as set forth above.

B. The Text Leads The Reader Intuitively To The Corrected Formula

If the drawings are not sufficient to inform a person of ordinary skill of the error in the formula and its proper correction, several textual recitations in the specification as filed also

would lead the person to the same conclusion. For example, at page 4, lines 15-19 of the specification as originally filed, is the following:

> As can be seen in Fig.5, the taper shape is such that the width of the waveguide 22 gradually increases, in a generally non-linear manner, from the input end 21 coupled to the input waveguide 20, to the output end 23 coupled to the two output waveguides.

Later on, at p. 9, lines 21-23, the specification implies that in the Fig. 5 embodiment, the tapered waveguide continues to "widen in width along it entire length L until it joins with the output waveguides."

Finally, the text clearly defines w_{in} as the width of the waveguide at the input (z=0) position and w_{out} as the width of the waveguide at the output (z=L) position, and both w_{in} and w_{out} are used in the formula.

These three observations exclusively from the text of the specification would mean to the person of ordinary skill that: (1) the formula should produce a waveguide width at the output (i.e. at z=L) which is larger than the waveguide width that it produces at the input (i.e. at z=0); (2) the formula should define a waveguide width which increases continuously from the input to the output; and (3) the formula should produce a waveguide width which is equal to w_{in} at the input (z=0) and w_{out} at the output (z=L).

As regards the first of these characteristics, that the formula should produce a waveguide width at the output (i.e. at z=L) which is larger than the waveguide width that it produces at the input (i.e. at z=0), a person of ordinary skill would recognize that the formula as originally filed always produces a taper shape in which the width at the output end is the *same* as the width at the input end. This can be seen by noticing that in the formula for z(t), z(t)=L (i.e. the output end position) when t=1. But when t=1 is inserted into the equation for w(t) as originally filed, the equation reduces to $w(t)=w_{in}$, which is the same as the width at the *input* end. The fact that the formula as originally filed produces a taper shape in which the width at the output end is the same as the width at the input end is also confirmed from the plots in column 2 of the table above, in which that characteristic is seen in all three example plots. Thus the person would have no trouble recognizing that the formula as originally filed was erroneous.

From the second and third characteristics, that the waveguide width increase continuously from the input to the output and that the waveguide width start at $w(t)=w_{in}$ and end at $w(t)=w_{out}$, the person of ordinary skill would recognize that these characteristics could be achieved from the

formula as originally filed, if one were to terminate the shape at the longitudinal half-way position (i.e. at z=L/2), and stretch the shape longitudinally to the full length (i.e. to z=L), with most of the stretching occurring as z approaches the half-way position of the formula as originally filed. Such a modification is the same as requiring the width to vary half as quickly along the longitudinal (z) axis, than occurs in the formula as originally filed. Since the parameter responsible for the speed of the width variations as one moves along the longitudinal axis, is the argument of the cosine term in the formula for w(t), it would be evident to the person that the described characteristics could be achieved if this argument were to be half what is shown in the formula as filed. With this reasoning the person of ordinary skill would come up with the correction that "πt" should be substituted for "**2**πt" in the formula as filed, and the resulting formula would satisfy the described characteristics that the waveguide width increase continuously from $w(t)=w_{in}$ at the input, to $w(t)=w_{out}$ at the output. The modified formula thus achieved is the same as the above "formula as corrected".

As a further confirmation that substitution of "πt" for "**2**πt" in the formula as filed is the correct modification, the person of ordinary skill would note further that this is a very simple correction, easily explained by a purely typographical error.

Accordingly, it is submitted that the text excerpts identified above, completely apart from the shapes in the drawings, also would lead a person of ordinary skill to know not only that the formula as filed is incorrect, but also exactly what needs to be corrected in the formula as filed in order to produce waveguide shapes that satisfy the textual description.

C. The Text Delivers The Correct Equation Purely By Mathematical Derivation

The fact of the error and its correction would be evident to a person of ordinary skill also from various other textual excerpts from the specification as originally filed, and from which the person would arrive at the correct equation purely by mathematical derivation.

At numerous places the text mentions that the shape of the taper is a cosine taper of some kind. See, for example, p. 3, lines 12 and 28; p. 4, lines 3 and 28; p. 6, lines 20 and 23; p. 7, line 16, p. 8, line 6, 11, 15 and 16. To a person of ordinary skill this would mean that a curve describing the width of the taper has the form:

$$w(t)=\alpha\cos(\beta t+\delta)+\gamma,$$

where α, β, δ and γ are not yet defined.

The text also states that the taper merges substantially continuously with the input waveguide. See, for example, p. 2, line 25; p. 6, lines 21-24; and the abstract. This means the slope of the waveguide is zero at the beginning of the waveguide (i.e. at z(t)=0 or t=0), which occurs when δ in the above equation is zero. This reduces the above equation to:

$$w(t)=\alpha\cos(\beta t)+\gamma.$$

The text also states:

> p is a shape factor, ... which basically controls the slope in the middle (z=0.5L) of the taper. (Specification, p.5, lines 6-9.)

and:

> The taper angle gradually increases towards the output waveguides until after the perturbation introduced by the factor p. (Specification, p. 7, lines 1-2).

Taken together, a person of ordinary skill would interpret these texts in the application as filed as describing a shape in which the "taper angle" gradually increases towards the output waveguides until after the middle longitudinal position (z=0.5L or t=0.5) of the waveguide. The "taper angle", as explained in the specification at p.6, lines 25-26, is defined as the angle of the tapered sides of the waveguide relative to the propagation direction, i.e. its slope. Therefore, this description calls for the slope of the curve (not the width of the waveguide) to reach a maximum at z=0.5L (or t=0.5).

A maximum slope at z=0.5L is written

$$\left.\frac{\partial slope}{dz}\right|_{z=0.5L}=0 \quad \Leftrightarrow \quad \left.\frac{\partial slope}{dt}\right|_{t=0.5}=0$$

where

$$slope=\frac{\partial w}{\partial z}=\frac{\partial w}{\partial t}\frac{\partial t}{\partial z}.$$

Working out the mathematics yields:

$$\left.\frac{\partial^2 w}{\partial t^2}\right|_{t=0.5}=0 \quad \Leftrightarrow \quad -\alpha\beta^2\cos(0.5\beta)=0 \quad \Leftrightarrow \quad \beta=\pi+2N\pi$$

with N an integer. Moreover N has to equal 0 in order to satisfy the implication at p. 9, lines 20-23, that in the Fig. 5 embodiment the waveguide continues to widen along its entire length L until it joins with the output waveguides. Thus β=π.

Furthermore, the input width is indicated by the symbol w_{in} and the output width of the taper is indicated with the symbol w_{out}. Thus:

$$\begin{aligned} w\big|_{t=0} &= w_{in} \\ w\big|_{t=1} &= w_{out} \end{aligned}.$$

Combined with the above observation that $\beta=\pi$, the person would arrive at:

$$w(t) = w_{in} + \frac{w_{out}-w_{in}}{2}\left[1-\cos(\pi t)\right],$$

which is the above "formula as corrected".

Accordingly, the formula as corrected in Applicant's last Response would be not only evident from the other statements in the specification, but actually derivable from those statements.

In light of the above, Applicant respectfully submits that a person of ordinary skill would find the evidence in the application as a whole overwhelmingly to point to not only the fact of an error in the formula for w(t) as originally filed, but also that it should be corrected by making the amendment set forth in Applicant's Response A. Accordingly, Applicant submits that no new matter was added by the amendment, and the objection to the amendment has been overcome.

II. OBJECTION TO CLAIM 5

The Examiner objected to claim 5 because of the use of the term "substantially." The Examiner correctly asserted that applicants indicated in Response A that the term "substantially" had been deleted from the claim in the amendment when, in fact, the amendment was not included.

Claim 5 has now been amended herein to delete the word "substantially".

Accordingly, it is believed that this objection has been overcome.

III. ART REJECTIONS

The Examiner rejected claims 1, 13 and 14 under 35 U.S.C. §102(e) as being anticipated by Bulthuis. The Examiner also rejected claims 1-8 as being obvious over a combination of Bouda and Laurent-Lund, and rejected claim 9 as being obvious over a combination of Bouda, Laurent-Lund and Li.

A. Rejection of Claims 1, 13 and 14 under 35 U.S.C. §102(e)

The Examiner rejected claims 1, 13 and 14 under 35 U.S.C. §102(e) as being anticipated by Bulthuis et al. (US 6,768,842).

1. <u>Independent Claim 1</u>

Claim 1 has been amended to incorporate the limitations from former claim 14, calling for a splitter comprising, among other things:

> at least two output waveguides;
>
> ... wherein ... the non-adiabatic tapered waveguide has a shape that forms a double-peaked field at the junction between the tapered waveguide and the output waveguides, each of the peaks entering a respective one of the output waveguides.

Bulthuis teaches the use of a non-adiabatic tapered waveguide at the entrance 9 to the first slab portion 3 of an AWG. The non-adiabatic tapered waveguide might form a double-peaked field at the entrance to the first slab portion, but the first slab portion does not constitute "*at least two* output waveguides".

The waveguide array portion 8 of the AWG in Bulthuis of course includes at least two waveguides, and presumably these are the waveguides that the Examiner considers to constitute the "output waveguides" of Applicant's claim. But the entrance to these "output waveguides" is located at some distance across the first slab from the non-adiabatic tapered waveguide output, and at that distance the field is no longer double-peaked.

Accordingly, Bulthuis fails to satisfy the limitation of Applicant's claim calling for the non-adiabatic tapered waveguide to have " a shape that forms a double-peaked field *at the junction between the tapered waveguide and the output waveguides*.

Since Bulthuis fails to teach a limitation called for in Applicant's claim 1, it cannot anticipate. Accordingly, claim 1 should be patentable over Bulthuis.

B. <u>Dependent Claims 13 and 14</u>

Claim 13 depends from independent claim 1 and therefore is believed to be patentable for at least the reasons set forth above with respect to independent claim 1. In addition, claim 13 adds its own limitations which, it is submitted, render it patentable in its own right.

Applicant has reviewed the grounds for rejection of claim 13 as stated by the Examiner and respectfully does not agree with the positions taken. Nevertheless Applicant does not believe it necessary to discuss his views on these claims further, since claim 1 is believed patentable as

set forth above. Applicant respectfully reserves the right to present his further points regarding claim 13 should it become necessary in the future.

Accordingly, claim 13 is believed to be patentable.

Claim 14 has been canceled.

Accordingly, claims 1 and 13 are believed to be patentable over Bulthuis.

C. Rejections of Claims 1-9 under 35 U.S.C. §103(a)

The Examiner has repeated the rejection of claims 1-8 under 35 U.S.C. §103(a) as being unpatentable over Bouda in combination with Laurent-Lund, and the rejection of 9 under 35 U.S.C. §103(a) as being unpatentable over a combination of Bouda, Laurent-Lund and Li.

With respect to independent claim 1, Applicant respectfully continues to disagree with the Examiner's analysis. However, Applicant believes the rejection is moot.

In particular, independent claim 1 has been amended to incorporate the limitations of former dependent claim 14, which was not rejected over the combination of Bouda and Laurent-Lund.

Accordingly, Applicant respectfully submits that independent claim 1 should now be patentable over combination of Bouda and Laurent-Lund.

With respect to dependent claims 2-9, these claims all depend ultimately from independent claim 1 and therefore should be patentable for at least the same reasons as independent claim 1. In addition, these claims each add their own limitations which, it is submitted, render them patentable in their own right.

Applicant has again reviewed the grounds for rejection of these claims as stated by the Examiner and respectfully continues to disagree with them. As in Response A, however, Applicant does not believe it necessary to discuss his views on these claims further, since claim 1 is believed patentable as set forth above. Applicant again respectfully reserves the right to present his further points regarding these claims should it become necessary in the future.

Accordingly, claims 2-9 are believed to be patentable as well.

IV. OTHER MATTERS

A. Other Corrections to Specification

In addition to the amendments mentioned above, the specification has also been amended to correct the reference in the specification that should have referred to Figs. 7(a)-7(c) instead of to Figs. 6(a)-6(c). No new matter is added since a person of ordinary skill would have recognized the existence of these typographical errors and would have recognized the corrections made herein.

B. New Claims

New claim 15 is added to more particularly point out an aspect of the invention.

C. References Cited by the Examiner

The references newly cited by the Examiner but not relied upon have been reviewed, but are not believed to render the claims unpatentable, either singly or in combination.

V. CONCLUSION

In light of the above, it is respectfully submitted that all of the claims now pending in the subject patent application should be allowable, and a Notice of Allowance is requested. The Examiner is respectfully requested to telephone the undersigned if he can assist in any way in expediting issuance of a patent.

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The Commissioner is authorized to charge any underpayment or credit any overpayment to Deposit Account No. 50-0869 (File No. GEML 4793-3) for any matter in connection with this response, including any fee for extension of time, which may be required.

Respectfully submitted,

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